

On some Queensland Trematodes, with Anatomical Observations and Descriptions of New Species and Genera.¹

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With Plates 22—27.

THE Trematodes comprising the subject-matter of the present work were collected by officers of the Institute and forwarded to me from time to time by the director, Dr. Anton Breinl, together with notes on the location of the parasites in their hosts and on the methods of preservation employed. The specimens were fixed for the most part in hot 70 per cent. alcohol, or in sublimate acetic, hot or cold; and, in cases where the form of the worm seemed to require it, some were fixed under slight pressure. The specimens converted into whole mounts I have generally stained in Ehrlich's or Delafield's hæmatoxylin and cleared in clove oil; all the forms except two, which were represented by single specimens, were studied by means of serial sections as well as in whole mounts.

I wish to thank Dr. Breinl for giving me the opportunity to study these forms, some of which presented some very interesting features: I have also to thank Professor Haswell, in whose laboratories the work was carried out, for valuable suggestions and criticism, as well as for the loan of much of the literature from his private library.

¹ A report on the Trematodes collected by the Australian Institute of Tropical Medicine during the years 1911 and 1912.

The worms were obtained from mammals, birds, reptiles and fishes, and comprise the following species:

From MAMMALS:

Opisthotrema cochleare Fischer, from the œsophagus of *Halicore dugong*.

Rhabdiopœus taylori gen. et. sp. n., from the intestine of *Halicore dugong*.

From BIRDS:

Echinostoma revolutum Froelich, from the intestine of *Anas superciliosa*.

Patagifer bilobus Rud., from the intestine of *Platalea regia*.

Typhlocœlum reticulare sp. n.,¹ from the intestine of *Anseranas semipalmatus*.

Allopyge antigones gen. et. sp. n.,¹ from the intestine of *Antigone australasiana*.

From REPTILES:

Polyangium linguatula Lss., from the intestine of *Chelone midas*.

Octangium sagitta Lss., from the intestine of *Chelone midas*.

Microscaphidium aberrans Lss.,² from the intestine of *Chelone midas*.

Diaschistorchis pandus Brn., gen. n., from the intestine of *Chelone midas* and *Chelone imbricata*.

From TELEOST FISHES:

Pleorchis oligorchis sp. n., from the intestine of *Tetraodon hispidus*.

Steringotrema pulchrum sp. n., from the intestine of *Tetraodon hispidus*.

From ELASMOBRANCH FISHES:

Petalodistomum polycladum gen. et. sp. n., from the body-cavity of *Dasybatis kuhlii*.

¹ As the relatives of these two forms usually occur in the body-cavity of birds, I made special inquiries about the location in the hosts, and am assured by the collector that they were obtained from the intestine.

² Collected by Dr. H. L. Kesteven at Mast Head Island.

Petalodistomum cymatodes sp. n., from the body-cavity of *Dasybatis kuhlii*.

In the new species and genera a diagnosis of each is given, together with a more extended account of the anatomy and remarks on the affinities and position in the system.

FROM MAMMALS.

On two occasions a number of trematodes of remarkable form were collected by Mr. F. H. Taylor, of the Institute, from the intestine of dugongs (*Halicore dugong*), caught off the Queensland coast. From the first animal examined sixteen of these worms were obtained; from the second, ten. As the discoverer of the form, I have associated Mr. Taylor's name with the species. Allied in their general organisation to the monostomid family *Notocotylidæ*, these worms exhibit a number of peculiar and unique features, as set out in the following description :

*Rhabdiopœus*¹ *taylori* gen. et sp. n. (Figs. 1-4 and 15-26.)

Diagnosis.—Large size, elongated, rounded at each end, convex dorsally and concave ventrally. Ventral surface covered with large hooks. Excretory pore on the dorsal surface near the posterior end. Complex, protrusible proboscis lies in a cavity near the posterior end of the body. No pharynx; intestinal limbs joined at their posterior ends by a transverse commissure. Genital pore close alongside the sucker; copulatory organs very elongated and comparatively narrow, the cirrus sac surrounding only a part of the vesicula seminalis. Testes symmetrically placed in the hinder end of the body, outside the intestinal limbs. Ovary between the testes; large shell-gland near the ovary. No Laurer's canal nor receptaculum seminis. Yolk-glands behind the testes and outside the

¹ *ράβδιον*, a little rod; *ποιων*, to make.

intestinal limbs. Coils of the uterus running transversely, very numerous and close together, extending outwards a little beyond the intestinal limbs. Eggs small, operculated, with a long filament at each end.

Host: *Halicore dugong*, in the intestine.

Type-specimen in the Museum of the Australian Institute of Tropical Medicine, Townsville, No. T. 33. Co-type in the Australian Museum, No. W. 363.

These worms are large in size, up to 22 mm. long by 5 mm. broad. In shape they are elongated and lancet-like, gradually tapering to a rounded point in front, broader and more bluntly rounded off behind. While the body is comparatively thin anteriorly, it becomes very thick at the posterior end, where the gonads and the peculiar digitate organ lie. The dorsal surface is convex; the ventral flat or slightly concave in front, but more deeply concave in the posterior region, where the lateral and posterior edges of the body are turned in ventrally.

The ventral surface of the body is covered by a dense mat of hooks, the bases of the thick shafts of which form a tessellated pattern all over it. Each hook, sickle-shaped in longitudinal section, consists of a stout shaft and a backwardly directed bifid point, turned almost at right-angles to the shaft. They are 0.107 mm. long and 0.064 mm. broad at the base. These hooks are set in a very thick cuticular layer (figs. 15 and 16), which is apt to peel off in large patches or to come off bodily from the whole surface. This may happen, not only in the case of specimens fixed in hot sublimate acetic, but also in those specimens fixed in hot 70 per cent. alcohol. The majority of the specimens, however, preserved this layer intact.

The sucker, almost circular in form, measures 0.733 mm. in diameter in specimens 22 mm. long—i. e. is almost one thirtieth the body-length. It is subterminal and directed ventrally. There is no pharynx, but the œsophagus, which is moderately long and stout-walled, leads directly out of the oral sucker. The intestinal limbs are very thin-walled. They

lie at first close together, but gradually diverge till they come to occupy positions at the junctions of the middle with the lateral thirds of the body, when they run backwards parallel to the lateral body-edges till they reach the level of the testes. Arrived at the anterior faces of the testes they bend inwards, enclosing the ovary, but lying on the inner side of, and dorsal to, the testes. Between the posterior ends of the testes they lie very close together. Behind them they diverge in a circular curve on each side, and, keeping pretty close to the rounded posterior end of the body, become confluent in the extreme posterior end. In this circular part of their course behind the testes a few short cæca are given off; otherwise they are unbranched and run fairly straight. They lie dorsal to the loops of the uterus.

On the dorsal surface of the body, near the posterior end, there is a large circular or oval opening leading into a spacious chamber, in the floor of which the excretory pore lies. Nine tunnel-like, tubular spaces, arranged in an anterior and two lateral groups of three each, branch off from this chamber into the parenchyma of the body, which is here very thick, and in each tunnel there lies a thick cylindrical finger-like process. Each lies quite free in its tunnel except at its base, where it becomes continuous with the tissues of the body (fig. 20). The three in the anterior group are longer than the others. These processes are muscular and extensible, and are capable of being thrust out for a considerable distance through the opening on the surface of the body. Each process or proboscis is circular in transverse section (figs. 3 and 23) and possesses a strong musculature. The circular fibres form a complete layer on the surface. Within this lies a circle of strong longitudinal fibres. Lying within the latter are found glandular cells which form rhabdite-like bodies and mucus or some similar homogeneous secretion. The cavities in which the processes lie are filled up, or partly filled up with mucus, which contains myriads of small rod-like bodies very similar to the rhabdites of *Temnocephala* and the *Turbellaria*. Each gland-cell is pear-shaped, and opens

on the surface of the process through a long duct which runs between the longitudinal muscle-fibres. Just at the tips of the processes the muscular layers are much reduced, and the gland-cells seem to have converted their entire protoplasm into mucus and rhabdites (fig. 4). Lying in the middle of the parenchyma of the process is a large space surrounded by a very definite muscular layer, as well as several smaller cavities. With the central space in each process a large branch given off from the excretory vesicle communicates (fig. 22). Fluid forced into this channel from the excretory system apparently takes part in the protrusion of the process, and, together with the action of the muscular system of the process, would render it tense.

These processes, according to Taylor, who found them, do not seem to be used in any way for attachment. The function of rhabdites in the flatworms seems to me to be obscure, no very satisfactory explanation having been offered for them. In this case they probably give a certain amount of stiffness to the secretion of the processes, and may have an irritating effect. The whole organ is most probably used for cleaning up an area of the wall of its host's intestine, so as to make a place to which the sucker can be effectively applied.

Muscular System.—The muscular layers of the body-wall are very strongly developed. A complete layer of circular fibres lies immediately adjacent to the cuticle; within the circular is a thick layer of longitudinal fibres, and internal to this is a layer of diagonal fibres, somewhat thicker than the outer circular layer. A dorso-ventral system of large muscle-fibres is developed to a very marked extent (figs. 15 and 16). The majority of these are fairly perpendicular to the dorsal and ventral surfaces of the body; many, however, are oblique in their direction. At each end, at the point where they reach the level of the diagonal fibres of the body-wall, these dorso-ventral fibres become divided into a number of branches, so that the area of their insertion into the cuticle is very much greater than the area of the cross-section of the fibre.

Excretory System.—The large branched vesicle opens into the proboscis chamber. The pore is provided with a strongly developed sphincter which is capable of keeping it closed when the fluid of the vesicle is being forced into the finger-like processes of the proboscis. The vesicle divides into four wide bays anteriorly and each of these bays becomes gradually narrowed into one of the four main trunk vessels. Those placed laterally diverge as far as the testes, round the outer sides of which they skirt, and then run forwards parallel to the sides of the body. Towards the anterior end they gradually trend inwards, and at a level just in front of and ventral to the intestinal fork they become joined in the form of a circular arch (fig. 26). All along their course they are provided with a number of wide side branches, regularly given off on the outer side and extending to the edge of the body (fig. 1). These branches do not anastomose with one another. The two vessels given off from the vesicle nearer the middle line pass the testes on the inner side and run forwards parallel to and within the intestinal limbs. They also give off a number of branches, but end blindly in front near the intestinal fork, without forming a transverse anastomosis. The four main excretory vessels and the intestinal limbs are placed approximately in the same plane, so that they all appear together in the same horizontal (parallel to the ventral surface) section (fig. 26).

Nervous System.—A pair of large cerebral ganglia are connected by a very thick commissure which crosses dorsally over the middle of the œsophagus (fig. 19). The principal trunks, in the form of a pair of lateral nerve-cords, gradually diverge outwards towards the sides of the body, at the same time sinking ventrally so that at a point not far behind the intestinal fork they come to occupy a position immediately internal to the muscular layers of the ventral body-wall (fig. 15). From the lateral trunks many small nerves are given off and are distributed laterally, inwards and dorsally.

Reproductive Organs.—The genital opening is at the anterior end, on the ventral surface, quite close to the sucker

on the right side near its middle. The testes are very large, about 2 mm. by 0.94 mm., with deeply lobed outline, and lie just behind the junction of the third and the last body fourths. They lie side by side, one on each side of the middle line, with their long axes obliquely placed, so that while their posterior ends are near together their anterior ends are some distance apart. Between the testes, within the bay formed by their divergence, the ovary and shell-gland lie, near the middle line.

The two vasa deferentia, arising near the middle of the anterior surface of each testis, meet just in front of the ovary to enter the vesicula seminalis. The latter is of extraordinary length and pursues a tortuous course, never far from the middle longitudinal line of the body, through half the animal's length. It occupies a position dorsal to the coils of the uterus. Only a comparatively small part of it lies within the cirrus sac, which is a cylindrical, muscular tube (figs. 24 and 25) running pretty straight through the anterior fourth of the body. Arrived in the posterior end of the cirrus sac the vesicula seminalis soon gives place to the ejaculatory duct, traversing the muscular penis. The proximal end of this ejaculatory duct is surrounded by a conspicuous prostate (fig. 25), which causes the cirrus sac to be much wider behind than in front. The penis and sac are of very unusual length compared to their diameter.

The ovary is a smooth-edged, oval body of considerable size, 0.89 by 0.57 mm., though much smaller than the testes. The "shell-gland," which lies alongside, is also very large, 0.82 by 0.49 mm. The oviduct, after traversing this organ, begins a series of transverse windings that run on as the uterus, in the form of a tube of comparatively narrow bore, but very great length. The very numerous coils of the uterus lying close together run from side to side in the ventral part of the body. Situated ventral to the vesicula seminalis, intestinal limbs and main excretory vessels, they fill up all this part of the body from the gonads behind to the level of the meeting of the first and second body fourths. From this point the vagina runs

forwards in a fairly straight course, more or less parallel to the cirrus sac, and about equal to it in length, to the genital opening. The coils of the uterus in a lateral direction reach the outer excretory trunks. There is no Laurer's canal nor receptaculum seminis.

The yolk-glands are situated laterally behind the testes. Each lateral mass consists of grape-like groups of oval follicles, which are small oval bodies varying from 0.099 by 0.064 to 0.107 by 0.077 mm. There are 12 to 15 follicles in each group; and each lateral mass consists of about 50 of these groups.

The eggs are thin-shelled, 0.026 mm. long by 0.015 mm. broad, operculated, and with a long filament at each end (fig. 2, *a* and *b*). The filaments vary a good deal in length, apparently becoming longer during their passage along the uterus; for while those eggs in the first few coils of the uterus, near the ovary, generally possessed quite short filaments, all the eggs in the more distant coils had quite long filaments, up to 0.279 mm. long, i. e. more than ten times the length of the egg.

Rhabdiopœus appears to me to be a member of the family *Notocotyliidæ* Lühe and sub-family *Notocotylinæ* Kossack (18), in spite of the absence of the rows of glands on the ventral surface generally found in members of this group, and in spite of the presence of the complex proboscis. These two structural characters are special features of perhaps generic rank, but not, in my opinion, of sufficient importance to separate the form from Kossack's sub-family. In their general organisation they agree well with the members of that sub-family (18, p. 554), coming nearest perhaps to *Catatropis* Odhner (48). The general arrangement of the reproductive organs and their ducts agrees fairly well with what obtains in *Catatropis*, e. g. the position and form of the testes and ovary; the form and situation of the vesicula seminalis, cirrus sac and cirrus, of the uterus and vagina; the vitelline glands, however, differ in lying behind instead of in front of the testes. The structure of the excretory system

also agrees pretty well with that of *Catatropis*. *Rhabdio-*
pœus differs from the latter further in having the intestinal
limbs fused behind, in the absence of the serial ventral
glands, as well as in the presence of the complicated proboscis
and the thick layer of spines on the ventral surface.

Opisthotrema cochleare Fisch.

Eleven specimens were found in the œsophagus of
Halicore dugong, by Dr. Strangman, at Port Darwin.
They were smaller than Semper's specimens, on which
Fischer worked, and were all sexually immature. The
largest specimen measured 7 mm. long by 4 mm. broad.
The majority were close to this in size, while the smallest
was only 3 mm. long. The sexual ducts were all well formed,
though the gonads themselves were only represented by very
small patches of cells. The already formed cirrus distinguishes
these specimens at once from *O. pulmonale* von Linstow
found in the lungs of the same host. The position of the
testes is also different, being external to the intestinal limbs
in *O. cochleare*, but internal to them in *O. pulmonale*
(24). Fischer (14) mentions the spines on the ventral surface
of the species under discussion, but makes no mention of the
fact, readily seen in sections, that the anterior part of the
dorsal surface bears smaller, more scattered spines.

FROM BIRDS.

Fam. Echinostomidæ.

Echinostoma revolutum Froel.

One complete specimen, and a fragment consisting of the
posterior half, were obtained from the intestine of the
"black-duck," *Anas superciliosa*. According to Looss
this species of worm (described under name *E. echinatum*
R.) exhibits considerable variation, and the description given

by him (30, pp. 680-684) fits this specimen well. It is 12 mm. long by 1.9 mm. wide. There are 37 wreath spines, 15 dorsal, 6 on each side, and 5 on each ventral lobe. In its anterior part the integument of the body is thickly covered with small spines, which gradually decrease in number towards the posterior end, and quite vanish at the level of the posterior testes. The tests are as broad as long, and very deeply incised, so that each is six-lobed. I follow Dietz (13) in placing it as *E. revolutum* Froel.

Patagifer bilobus R.

A single specimen of this species was obtained from the intestine of the black-billed spoonbill, *Platalea regia*. It was fixed in sublimate-acetic-alcohol, slightly flattened, stained with hæmatoxylin, and mounted whole. It measures 17 mm. in length and 1.4 mm. in breadth anywhere behind the ventral sucker, except near the posterior end, where it narrows to a round blunt point; it is somewhat wider at the level of the ventral sucker. Except that the lateral wreath spines are pointed at their outer ends, it agrees in all respects with the description given by Dietz (13, pp. 417-419), and by Looss (30, p. 685), for *P. bilobus* from *Platalea leucorodia*.

Fam. Monostomidæ.

Sub-fam. Cyclocœlinæ.

Typhlocœlum reticulare sp. n. (Figs. 5, 6, 7, 27-30, and 33.)

Diagnosis.—Small, flat, leaf-like worms, about 4 mm. long. Integument smooth. Sucker very weak, with its opening ventrally placed. Intestinal limbs with short caeca on their inner sides; joined together by a transverse loop at their posterior ends. Excretory pore on the dorsal surface near the posterior end; vessels forming a ventral network.

Genital pore on the ventral aspect, just beneath the œsophagus. Testes large, much branched bodies; copulatory organs moderately developed. Ovary oval, small; no Laurer's canal nor receptaculum seminis. Uterus richly coiled in dorso-ventral loops, not passing outwards beyond the intestinal limbs, and filling up all the space between the intestinal limbs from the gonads behind to the intestinal fork in front. Follicles of the yolk-glands minute (0.022 mm.), extending from the beginning of the intestine in front, forming a loop behind the intestinal commissure behind.

Eggs 0.107 by 0.073 mm. (?)

Host: The pied goose, *Anseranas semipalmatus*, in the intestine.

Type-specimen in the Museum of the Australian Institute of Tropical Medicine, Queensland, No. T. 34.

Co-type specimen in the Australian Museum, No. W. 365.

Five specimens were obtained from the intestine of the pied goose, *Anseranas semipalmatus*, at Townsville.

They are small leaf-like forms, oval in shape, quite flat, and thin dorsoventrally, 4.3 mm. long by 1.83 mm. broad. The integument is quite smooth.

The anterior sucker is so weakly developed as to be almost non-existent. It is represented by a funnel-shaped depression opening on the ventral surface near the anterior end; its walls are provided with a few weak muscle-fibres, which are more concentrated near its base. At the bottom it opens into a very well-developed and muscular pharynx, 0.228 mm. long by 0.163 mm. broad.

The œsophagus is short but distinct, and divides behind into the two intestinal limbs, which run backwards parallel to the edge of the body and fuse together so as to complete the ring at the posterior end. A few short cæca are given off on the inner aspect of each limb.

Excretory System.—The excretory pore is on the dorsal surface, near the posterior end. It is surrounded by a distinct sphincter, and leads into a more or less spacious chamber situated wholly behind the intestine (fig. 5). Into

its anterior end two main excretory vessels open. These cross over the posterior intestinal loop and run forwards as far as the sides of the pharynx, where they end blindly. In their forward course they lie close to, and fairly parallel to the intestinal limbs, re-crossing them near their anterior end. On their outer sides they give off a number of mostly undivided branches; on their inner aspect they give off a number of branches which, anastomosing freely, form a network in the middle of the body (figs. 6 and 33) lying ventral to the uterus. From all the branches finer tubes are given off which end in flame-cells. These finer tubes are apparently intra-cellular, as not more than one nucleus could be made out in the wall of any of those examined. The walls of the larger vessels—the main trunks, network and branches—as well as the vesicle are composed of a nucleated syncytium.

Nervous System.—Two large cerebral ganglia, composed of the usual nerve-cells and fibres, lie, one on either side, in front of the pharynx (fig. 29). They are joined by a thick commissure, and give off a number of fine nerves to the integument in the front of the body. Behind, each gives off a thick nerve, the lateral nerve-cord, containing in its course many nerve-cells as well as fibres (fig. 7). These nerve-cords run backwards just outside the intestinal limbs, and in the extreme posterior end of the body, behind the excretory vesicle, join together to complete the circuit. Branches are given off, both on the outer and inner aspects of these nerve-cords, and at the points where they leave the main trunks little heaps of nerve-cells usually occur. The internal branches fuse with one another so as to form a network on the ventral surface of the body, just internal to the muscular layers, and ventral to the network of excretory vessels (fig. 27).

Genital System.—The common genital pore is situated on the ventral surface just beneath the œsophagus—i. e. in front of the intestinal fork. The testes are large branched bodies lying near the posterior end, but completely within the space bounded by the intestinal loop. They are somewhat obliquely placed one behind the other. The posterior, lying

in the bay of the posterior intestinal commissure, extends forward on the left side as far as the ovary in front. The anterior, while it does not extend so far posteriorly, reaches in front nearly to the middle of the body. The two vasa deferentia, each formed by the confluence of several smaller ducts, join one another about the middle of the body, whence they run forward as a single tube, ventral to the uterus, to a level approaching the anterior part of the intestine. Here this tube expands into an elongated vesicula seminalis which lies within the posterior end of the weakly developed cirrus sac. The latter lies partly in front of and partly behind the intestinal fork ending at the genital pore. The ejaculatory duct is somewhat twisted, and bears a small prostate in relation to its proximal end. The ovary is a small oval body (0.142 by 0.086 mm.), situated on the left side just inside the intestinal limb and in front of the posterior testis. The oviduct, running at first posteriorly, soon expands into the ootype, which is surrounded by the "shell"-glands and lies behind the ovary. The uterus, entirely confined to the space between the intestinal limbs and filling up almost the whole of this space, is closely coiled, and presents a peculiar appearance in whole mounts owing to the coils running backwards and forwards between the dorsal and ventral surfaces (figs. 28 and 30). The terminal part is a well-marked vagina opening into the genital chamber.

The yolk-glands, consisting of very small and very numerous follicles (0.022 mm. in diameter), cover the whole of the outer aspect of the intestinal limbs, and to some extent spread right round them, but are mainly confined to their ventral and outer surfaces. The two lateral groups become continuous round the posterior aspect of the intestine. The transverse yolk-ducts leave the longitudinal ones about the level of the ootype, and join together to form a small yolk reservoir that opens into that chamber. There is no Laurer's canal nor receptaculum seminis.

In none of the specimens did the uterus, a comparatively immense tube, contain any eggs, but a few were found on the

surface of the body or in the intestine. As no other trematodes were found in the host, which was subjected to a careful examination, and the form and size of the eggs found conform pretty well with those in closely related species, it is almost beyond doubt that these eggs belong to the animal with which they were found associated. They are large, oval in shape, yellow in colour, 0·107 mm. long by 0·073 mm. broad.

This worm appears to be closely related to *Typhlocœlum cucumerinum* Rud. as described by Kossack (18, pp. 543-548), in spite of the occurrence of the small ventral sucker in the latter. I have been able to find no trace of such a sucker in my specimens, either in the whole mounts or sections. The occurrence of such a sucker in worms, in all other respects obviously associated with the Monostomidæ, must, I think, be looked upon as an atavism—a thing of local interest, but of no great systematic importance.

T. reticulare differs from *T. cucumerinum* in size and shape; in the more elongated form of its pharynx; in the greater extension forward of the anterior testis and the greater length of the separate vasa deferentia; in the arrangement of the yolk-glands behind the intestine; in the much smaller size of the ovary; in the very characteristic dorso-ventral winding of the uterine loops; and in the considerably smaller eggs.

Allopyge antigones gen. et sp. n. (Figs. 7, 31 and 32.)

Diagnosis.—Size large, body muscular, narrowed towards the ends; small dorsal muscular plug projecting into the cavity of the oral sucker. Intestinal limbs hardly branched, not straight, but undulating. Genital pore at or behind the intestinal fork; cirrus sac lying therefore entirely behind the intestinal fork. Copulatory organs moderately developed. Yolk-glands more or less in grape-like follicles, lying closely upon the ventral and outer aspects of the intestinal limbs, meeting behind the intestine and extending forwards nearly up to the intestinal fork. Ovary and testes lying on a

straight line, inclined at an angle to the antero-posterior axis of the body; but the ovary not so closely associated with the posterior testis as in *Hyptiasmus*. Anterior testis separated from the posterior and the ovary by a number of uterine loops. Uterine loops, in the posterior half of the body, extending out beyond the intestinal limbs; but no loops extending backwards beyond the posterior testes as in *Hyptiasmus*. No Laurer's canal; a receptaculum seminis present or absent.

Type species: *A. antigones*; from the small intestine of the Australian crane, *Antigone australasiana*.

Type-specimen in the Museum of the Australian Institute of Tropical Medicine, No. T. 35.

Co-type in the Australian Museum, No. W. 366.

This genus differs from *Hyptiasmus*, to which it is closely related, mainly, in the undulating course of the intestinal limbs, in the position of the genital pore, at, or just behind, the intestinal fork, and in the consequent situation of the cirrus sac entirely behind it; in the absence of uterine loops passing behind the posterior testis, and in the presence (probably invariable) of a receptaculum seminis. With this genus probably *Hyptiasmus ominosus* Koss. and *H. adolphi* Stoss. should be associated. I have not been able to see the original text of Stossich's work (57), but know its contents only through Braun's abstract in the 'Zoologisches Centralblatt' and by means of Kossack's criticisms of it, so that I do not know whether *H. adolphi* is the worm of this group in which Stossich found the receptaculum seminis, but suspect that it is so. Three specimens of *A. antigones* were obtained from its host; one was sectioned, and the other two were made into whole mounts. They are large, flat, leaf-like worms, about 20 mm. long and 4 mm. broad. While the ventral surface is flat the dorsal is somewhat convex. The integument is rough with little transverse corrugations.

The character of the oral sucker and the pharynx is exactly the same as in *T. reticulare*. The structure which I have called the pharynx has been generally looked upon, in related

species, as the oral sucker. Van Beneden, for instance (2), calls it the "bulbe buccale"—terms he applies to the oral sucker in other malacocotyleans described by him. He noticed the funnel-shaped depression in the anterior end of the body leading down to this "bulbe buccale," and his fig. 4, pl. xii, in the work quoted corresponds closely to the condition of affairs in *T. reticulare* and *A. antigones*. The walls of this funnel-shaped depression, in the specimens examined by me, are provided with muscular fibres, especially at its base (fig. 31), and I am convinced that here we have to do with the real oral sucker, very poorly developed though it be.

Monticelli (40) has called it a præ-pharynx, and Kossack (18) a præ-pharynx (p. 501) and a mouth-cavity ("mundhöhle," p. 543). The pharynx is a typical malacocotylean pharynx not only in regard to its position and shape, the structure of its muscular walls and of its lining, but also in its relation to the nervous system, the two cerebral ganglia lying completely in front of it (fig. 29). This structure both Monticelli and Kossack recognise as the pharynx. The walls of both the oral sucker and the œsophagus are richly supplied with gland-cells.

In *A. antigonis* the pharynx measures 0.41 mm. long by 0.25 mm. wide, the œsophagus, 0.244 mm. long, the anterior testis, which is round, being 0.733 mm. in diameter, the posterior, which is oval and transversely placed, being 1.059 mm. long by 0.896 mm. broad. In outline the testes are slightly indented. The ovary, which is oval and smooth-edged, measures 0.407 by 0.326 mm.

The ventral network of excretory vessels present in *T. reticulare* and *A. antigones* probably also occurs in other related forms. Van Beneden (2, p. 72) speaks of an anastomosis near the anterior end between the two main trunks in *Monostomum mutabile*, and shows it in his figure (2, fig. 3), but obviously overlooked the ventral network through the want of a good series of sections.

In *A. antigones* the network is more richly developed, and there is a dorsal as well as a ventral network. The form

and position of the vesicle and its pore are much the same as in *T. reticulare*. The nervous system of the former also corresponds pretty closely with the arrangement described for the latter.

In the uterus the loops lying between the anterior testis and the middle of the body extend outwards beyond the intestine almost to the edge of the body, while the more anterior loops are confined to the space between the intestinal limbs. There are no backwardly directed loops extending behind the posterior testis as in *Hyptiasmus*. While there is no Laurer's canal, a very distinct receptaculum is present (fig. 32).

The eggs are very numerous, smaller and narrower than in *T. reticulare*, 0.094 mm. long by 0.055 mm. broad, yellow to light brown in colour.

FROM REPTILES.

Fam. Angiodictyidæ.

Polyangium linguatula Lss.

Ten specimens of this species were obtained from the intestine of *Chelone midas*.

Octangium sagitta Lss.

About one hundred specimens were obtained from *Chelone midas*, living along with the *Polyangium*.

Fam. Pronocephalidæ.

Diaschistorchis pandus Braun, gen. nov. (Figs. 9, 10, 34-37.)

In addition to a single specimen obtained from the intestine of a hawksbill turtle, *Chelone imbricata*, which I caught in Port Jackson, I have received from the Institute six specimens of a worm obtained from the intestine of *Chelone midas*, caught off the Queensland coast. These worms appear

to me to be identical with Braun's *Monostomum pandum* (9, p. 48) on the following grounds:

Professor Braun had at his disposal only a single specimen, which was mounted whole. As the worm is fairly thick and dense, it is, of course, impossible to view its anatomy completely in a single specimen.

As far as Braun's description goes my whole mounts agree with it very well, the differences being of such minor importance as to make it out of the question, in my opinion, to propose a separate species for my specimens. A study of serial sections, however, not only makes clear important points in the animal's structure that are quite impossible to see in the whole mounts, but also shows some of the appearances in the latter to be somewhat misleading. While the worm is undoubtedly one of the *Pronocephalidæ* Lss. (33), it does not fit into any of the genera at present established, so that I am obliged to propose a new genus for it, adding yet another to the list of genera containing only a single species in this family.

Four of the worms available to me for study I cut into sections, one transverse, one sagittal, and two horizontal longitudinal. With the help of these series I shall supplement Braun's description (9, pp. 48-50), afterwards giving a diagnosis of the genus *Diaschistorchis*, and a discussion of its relationships.

External Characters.—My specimens were all a little smaller than Braun's, varying in length from 8 to 9 mm., while being 2.5 mm. broad at the level of the cirrus sac and 3 mm. broad at the widest part, near the posterior end. The form of body is skiff-like, rounded at both ends, rather narrower in front, and gradually increasing in breadth to near the posterior end. The collar is less conspicuous than in the other members of the family, taking the form of a low kidney-shaped elevation of the surface of the body round the sucker on the dorsal side, but not produced into lobes or processes of any kind at its ventro-lateral ends. The dorsal surface of the worm is arched, both from side to side and, to a certain extent, antero-posteriorly; the ventral surface is

concave, and sometimes the posterior edge is turned forwards a little. The genital pore is found on the ventral surface, near the left side, some distance from the anterior end; the excretory pore is on the dorsal surface, a little in front of the posterior extremity. The sucker measures 0.57 mm. by 0.63 mm. in its longitudinal and transverse axes respectively in the smallest specimen, and 0.717 mm. by 0.782 mm. in the largest. Its opening is subterminal.

Alimentary Canal.—A thick-walled oesophagus, 0.326 mm. long, leads back from the sucker, and joins the intestine almost at right angles, the limbs running at first transversely and in the same straight line. There is no pharynx. The intestinal limbs extend backwards to the level of the excretory pore, and are provided with numerous side branches, both on their outer and mesial surfaces. Some of these lateral caeca become divided into two or three short branches (fig. 34). The intestinal limbs do not become arched in towards the median plane in the region of the testes, as so commonly happens in members of this family, but pursue a course fairly parallel to the sides of the body, converging a little at their posterior ends.

Excretory System.—The excretory vesicle is provided with the characteristic funnel-shaped end, bearing processes on its walls—the “rippen” of Looss (33)—as in *Epibathra* and other related genera. The capacious vesicle extends forwards as far as the ovary, and is produced on each side into three or four wide diverticula. From one of these pairs—the second from the front—the main vessels are given off and extend outwards till they reach the outer sides of the testes. Here each vessel divides into two branches, one running posteriorly, the other anteriorly (fig. 10). Each anterior branch pursues an undulating course, in seven or eight large waves, ending blindly near the sucker. Branches are given off both from the outer and inner aspects; the former end blindly, but the latter anastomose with one another in the space between the intestinal limbs, ventral to the uterus.

The Nervous System is of the usual type, consisting of a large cerebral ganglion on either side of the œsophagus, joined by a thick transverse commissure, and giving off a number of nerves besides the main, lateral nerve-cords. The latter run backwards in the interval between the intestinal limb and edge of the body on each side, giving off nerves to various parts (fig. 37).

Reproductive System.—In whole mounts the male and female ducts appear to open on the surface separately, but the sections show them opening into a shallow genital chamber (fig. 35), which lies laterally on the left side, outside the intestine. The testes are not only deeply lobed, but actually split up on each side into from four to six separate pieces, which meet in the middle line behind, so that the whole forms a U-shaped structure. The anterior pieces lie exactly ventral to the intestinal limbs; posteriorly they gradually converge on the middle line. The separate pieces are themselves deeply lobed. In whole mounts the separate parts, which are only connected by the ducts, overlap one another somewhat when viewed from the dorsal or ventral aspects, so that their separate identity is not quite apparent. The two vasa deferentia pursue a separate course forwards for some distance, and on meeting continue on as a single duct on the right side, between the uterus and the yolk-glands. The enlargement of this tube to form the vesicula seminalis occurs some distance behind the anterior end of the yolk-glands. The part of the vesicula seminalis lying in the region of the yolk-glands, the unpaired vas deferens and the separate right vas deferens are about equal in length, each lying near a third of the length of the yolk-glands. The vesicula seminalis is coiled throughout its whole length, the short part lying within the base of the cirrus sac, taking the form of an S-shaped curve.

The cirrus sac is a strongly developed, elongated, club-shaped structure, with thick muscular walls, lying obliquely across the body in the hinder part of the anterior body third. There is a well-developed pars prostatica, marked off from the

ejaculatory duct and penis by a shallow constriction. The vagina, which is surrounded near its termination by a mass of unicellular glands, is only about half as long as the cirrus sac.

The ovary is deeply lobed, about as large as one of the pieces of testis. It lies to the right of the middle line on a level with the anterior end of the testis. A large "shell-gland" lies to the side and somewhat behind it, in the middle line. Laurer's canal is present but there is no receptaculum seminis. The transverse yolk-ducts meet to form a small yolk reservoir on the dorsal surface of the "shell-gland." The small rounded follicles of the yolk-glands are massed in grape-like bunches, there being from eight to twelve of these bunches on either side. They lie on the ventral side of the intestine and extend from the testes behind to a level a little in front of the middle of the body. The coils of the uterus are confined to the space between the intestinal limbs.

The eggs measure 0.033 mm. long by 0.019 mm. broad. Those in the proximal part of the uterus have no filaments, but the older eggs in the more distal coils appear to possess a single fairly large filament at the narrow end attached to the operculum, and a bunch of fine filaments at the other end. In the sections a few of these eggs exhibited this character clearly, but in the majority of cases the filaments appear to have become separated and lie in the uterus amongst the eggs, in masses.

Diagnosis.—Body above middle size, skiff-like. Collar less conspicuous than in the other genera of this family, taking the form of a low swelling round the head. Intestinal limbs extending straight backwards as far as the excretory pore; not arched inwards towards the middle line in the region of the testes; richly provided with side branches throughout their whole length both on their inner and outer aspects. The excretory vesicle reaches the "shell-gland" in front, with wide lateral diverticula; the main branches running up to the head end in an undulating course, giving off branches, some of which anastomose. Genital

pore outside the intestinal limbs; copulatory organs strongly developed; cirrus sac large and club-like, vesicula seminalis long and coiled, extending back more than half-way to the gonads. Testes forming a U in the posterior end of the body, deeply lobed, and split up into several separate pieces on each side. Ovary lobed, near the anterior end of the testes. Laurer's canal, but no receptaculum seminis. Eggs with filaments.

Diaschistorchis is distinguished from all the other genera of its family by the less conspicuous development of the collar, by the form of the testes and the more complex arrangement of its excretory vessels, besides differing from each genus in a number of other respects. It appears to be nearer to *Epibathra* and *Glyphicephalus* than the others, agreeing fairly well with these in the general configuration of their organs except the testes; and, in the arrangement of its excretory vessels, differing from these less than from the other genera.

Specimens in the Museum of the Australian Institute of Tropical Medicine, No. T. 36.

FROM FISHES.

Fam. Fasciolidæ.

Pleorchis oligorchis sp. n. (Figs. 11, 38-40.)

Diagnosis.—Above middle size, rectangular in shape, without spines. Oral sucker very large and strong; ratio of oral to ventral sucker 7:3. Pharynx a little smaller than the ventral sucker, short œsophagus, intestinal limbs wide and straight, with a single anterior cæcum on each side. Excretory vesicle reaching the receptaculum seminis in front. Genital pore in middle line, in front of and very close to the opening of the ventral sucker. Testes in two parallel rows, generally five on one side and six on the other; no cirrus

sac. Ovary spherical; Laurer's canal and receptaculum present; uterus small; yolk-glands very richly developed.

Parasitic in the intestine of *Tetraodon hispidus* Linn. Type specimen in the Museum of the Australian Institute of Tropical Medicine, Townsville, No. T. 37.

Co-type in the Australian Museum, No. W. 367.

The largest specimen, fixed under slight pressure, measured 12 mm. long by 5 mm. broad; the smallest from the black toad-fish (*Tetraodon hispidus*?) 8 mm. long by 3.75 mm. broad. Eight specimens were obtained from this host; but a large number of specimens, which differed from these only in being smaller in size, 5-6 mm. long by 2 mm. broad, were obtained from the intestine of the spotted toad-fish (*Tetraodon hispidus*). The worms are flat and almost rectangular in shape in the preserved specimens, the sides being fairly parallel and the ends almost truncated. The integument is thick and shows a number of corrugations on the surface. There are no spines.

The oral sucker is very large and strong, in many cases retaining within its grasp a piece of the mucous membrane of the host's intestine. It measures 1.666 mm. in diameter. The opening is terminal and comparatively small, with a condensation of the tissues round its edge so that the latter is specially tough. The ventral sucker is much smaller and weaker, and measures 0.714 mm. in diameter. The ratio of the oral to the ventral sucker is 7:3. The pharynx is a little smaller than the ventral sucker, and in most cases was compressed in the longitudinal direction. There is a distinct præ-pharynx, and a short œsophagus 0.12 mm. long (fig. 38) leading into the intestinal limbs, which run at first horizontally, where they bend round to become longitudinal; a cæcum is given off which extends forwards as far as the middle of the anterior sucker. The main posterior limbs, which are wide, extend straight back, parallel with the sides of the body, into the extreme posterior end. They have no branches, but in contracted specimens the walls are thrown into transverse folds.

The excretory pore opens at the posterior end, generally into a more or less deep depression. The vesicle is long and voluminous, extending as a wide straight tube as far forwards as the receptaculum seminis. Here it divides into two comparatively narrow vessels which runs forwards near the inner sides of the intestinal limbs and end blindly near the anterior end. From these vessels a number of capillary branches are given off.

The genital pore lies in the middle line, in front of the ventral sucker, and very close to its opening; in most cases almost on its lip. The testes lie in two parallel rows close to the inner border of the intestinal limbs. They are not only variable in number, but also unequal in number on the two sides. In eleven mounted specimens there were nine with five on the left side and six on the right; one specimen had three on the left and five on the right, while another had two on the left and three on the right. The two latter were not small nor immature, but amongst the largest of those present. The testes are not divided into double dorso-ventral rows like those of *P. polyorchis* Stoss., described by Linton in 26, p. 460. Each testis is round and smooth, 0.476 mm. in diameter. The vesicula seminalis, lying close behind the ventral sucker, is large and pear-shaped. The ejaculatory duct, surrounded by a well-developed prostate, skirts round the left side of the ventral sucker, and, near its anterior border, opens into a tubular genital sinus. The latter, leading directly to the genital opening, in the form of a cylindrical tube, is 0.24 mm. long. There appears to be no cirrus sac; but the vesicula seminalis and the ejaculatory duct and prostate lie free in the body parenchyma.

The ovary is a smooth spherical body, 0.57 mm. in diameter, lying a little to the right of the middle line, near the anterior end of the testes. To its left is a large "shell-gland," and behind it a capacious receptaculum seminis. There is a Laurer's canal with comparatively thick walls. The uterus, running out laterally from the left side of the "shell-gland," is a comparatively small tube which reaches the level of the

anterior edge of the ventral sucker in three or four S-shaped bends, and opens into the genital sinus alongside the male opening. The eggs are never numerous. The yolk-glands, consisting of small rounded follicles 0.048 mm. in diameter, are very richly developed. In front they reach the level of the anterior border of the ventral sucker and are in this region confined to the lateral parts of the body. Passing backwards they gradually extend inwards to the middle line, so that in the posterior half of the animal they fill up the whole field, extending right across the body and back to the extreme posterior end. The eggs are thin-shelled, light in colour, 0.073-0.076 mm. long by 0.046 mm. wide.

This species differs from *P. polyorchis* Stossich in its larger size, in the absence of spines, in its much larger oral sucker, in the smaller number of testes, and in its spherical ovary.

Fam. Steringophoridae.

Steringotrema pulchrum sp. n. (Figs. 12, 41 and 42).

Diagnosis.—Middle-sized worms, almost lanceolate in shape. Ventral sucker in front of the middle of the body. Ratio of the oral to the ventral sucker 1:1.8. Pharynx more than half as large as the oral sucker; œsophagus very short; intestinal limbs reaching to near the posterior end. Excretory vesicle V-shaped, the limbs reaching the level of the oral sucker in front. Testes near the middle of the body; ovary in front of right testis; Laurer's canal present, but no receptaculum seminis; loops of the uterus confined to the space between the intestinal limbs; yolk-glands lateral to the intestinal limbs, not reaching the ventral sucker in front; eggs 0.043-0.048 mm. long by 0.032-0.035 mm. broad, thick shelled.

In the gullet of the black toadfish,¹ and the spotted toadfish.¹

¹ There seems to be some doubt whether these two fishes represent distinct species or colour varieties of the same species, *Tetraodon hispidus*.

Type-specimen in the Museum of the Australian Institute of Tropical Medicine, Townsville, No. T. 38.

Co-type in the Australian Museum, No. W. 368.

In size this species is 6 mm. long by 2·3 mm. broad, the greatest width being some distance behind the ventral sucker. The body is narrow in front of the ventral sucker, with fairly parallel sides; the part posterior to it is oval in shape. The integument is thick and wrinkled, but no spines are present. As is usual in the group, the suckers are very large and strong, the longitudinal and transverse diameters of the oral sucker being 0·46 mm. and 0·58 mm. respectively, while those of the ventral sucker are $0·847 \times 0·978$ mm., the ratio of the oral to the ventral being 1 : 1·8. The suckers are 1·3 mm. apart.

The pharynx is a conspicuous structure, but not so large as the oral sucker, measuring $0·342 \times 0·265$ mm. The œsophagus is very short, almost non-existent, while the intestinal limbs, which are somewhat voluminous, especially posteriorly, do not reach the posterior extremity by a distance of 1 mm.

The excretory vesicle may be described as V-shaped, and consists of two wide tubes extending from the level of the oral sucker to the extreme posterior end, where they are joined together by a short, transversely placed, triangular chamber which opens on the exterior at the posterior end. This part is surrounded by a mass of deeply staining cells. The two main limbs run at first along the inner side of the intestinal limbs. At the level of the testes they cross the intestine and proceed forwards, close to the sides of the body.

The genital pore is a little to the left of the middle line, just behind the pharynx. The two testes are almost symmetrically placed, one slightly in front of the other, and lie within the intestinal limbs. They are round or oval in shape and smooth-edged, 0·456 mm. in diameter. The vasa deferentia, after an elongated course, meet at the base of the vesicula seminalis, which lies wholly within the cirrus sac and is somewhat coiled. The prostate is well developed, and the penis large and thick. The cirrus sac is oval in shape, and its

walls are thick and muscular. The ovary is three-lobed, the lobes being somewhat indistinctly marked off by shallow grooves. It lies close in front of the right testis, and is smaller than that body, being 0.277 mm. in diameter. A small shell-gland lies on its left side in the middle line. There is a Laurer's canal, but no receptaculum seminis.

The coils of the uterus, in closely placed transverse loops on the left side, run back to the posterior end of the body—in the worm from which fig. 12 was drawn they do not extend so far back as usual—while the ascending loops keep mainly to the right of the middle line up to the level of the testes. From this point the uterus has a pretty straight course to the genital opening; the vagina is not conspicuously developed. The coils of the uterus are entirely confined to the space between the intestinal limbs. The yolk-glands consist of from six to eight tree-like groups of small follicles on each side. The follicles are about 0.017 mm. in diameter, and there are 500 or 600 of them in each group. The number of groups on each side of the body is sometimes different. Each group opens by a separate duct into the longitudinal duct. The yolk-glands lie in the lateral field of the body outside the intestinal limbs, and extend forwards as far as the anterior border of the testes, whilst behind they extend a little beyond the middle point between the testes and the posterior end of the body.

The oval eggs are thick-shelled (fig. 12, *a* and *b*) with an operculum at the narrow end, while the broad end is often provided with a blunt spike. The eggs measure 0.043–0.048 mm. long by 0.032–0.035 mm. broad, and the shells are 0.0027 mm. thick.

A single immature specimen was found amongst the full-grown ones. It was 2.58 mm. long by 1.17 mm. broad. The suckers and pharynx bore the same relations in size as the mature worms. The testes measured 0.179 mm. in diameter; the ovary 0.098 mm. There were no eggs, nor could any trace of an uterus be made out.

In addition to the specimens from the gullet of the black

toadfish, a large number of specimens were obtained from the gullet of the spotted toadfish, and they appear to me not to differ from this species except in their smaller size. They measured up to 4.25 mm. long by 1.78 mm. broad.

While I place this species in Odhner's genus *Steringotrema*, it appears to be more closely related to *Distomum vibex* Linton (27, p. 291, figs. 48-51) than to any of the three species enumerated by Odhner (51). *Distomum vibex* Linton evidently belongs to the same genus. *S. pulchrum* differs from Linton's species mainly in the disposition of the yolk-glands, in the shorter intestinal limbs, in the more confined distribution of the uterine loops, and in the size and shape of the eggs. It differs from *S. cluthensis* Nicoll, *S. pagelli* van Ben. and *S. divergens* Rud. in size, in the relative sizes of the suckers, in the very short œsophagus, in having the post-acetabular considerably longer than the pre-acetabular region, and in the very different disposition of the yolk-glands, as well as differing from each of the three species named in a number of other points.

Fam. Gorgoderidæ.

Sub-fam. Anaporrhutinæ Lss.

*Petalodistomum*¹ gen. nov.

Diagnosis.—Posterior part of the body very broad, almost circular and plate-like. Muscular pharynx present; short œsophagus. Genital pore at or behind the intestinal fork. Cirrus sac very weak; testes deeply lobed and divided into several distinct pieces, or broken up into a large number of rounded follicles, lying wholly outside the intestinal limbs. Large receptaculum seminis present but no Laurer's canal. Yolk-glands lying wholly within the intestinal limbs.

Type *P. polycladum*. Parasitic in the sting-ray, *Dasybatis kuhlii*.

¹ *πτεγαλον*, a plate.

The genus is closely related to *Probolitrema* Lss., differing from it principally in the fact that its yolk-glands are close together, lying within the space bounded by the intestinal limbs, while in the latter the yolk-glands are far apart and lie in the lateral part of the body quite outside the intestinal limbs (Looss, **33**, pp. 860 and 863, and Monticelli, **42**, tav v, fig. 52). It differs from *Anaporrhutum* Ofenheim in the testes being wholly outside the intestinal limbs.

Petalodistomum polycladum,¹ sp. n. (Fig. 13.)

Diagnosis.—Under middle size, petal-like, with the posterior part of the body almost circular. Ratio of oral to ventral sucker 1:1·6. Branched intestinal limbs. Genital pore at the level of the intestinal fork. Testes very large and more or less compact but divided into two or three pieces. Vesicula seminalis long, tubular and coiled. Ovary tri-lobed. Yolk-glands in two sets of small rounded follicles, close together, not extending outwards beyond the intestinal limbs.

Found in the body-cavity of the sting-ray, *Dasybatis kuhlii*.

Type-specimen in the Museum of the Australian Institute of Tropical Medicine, Townsville, No. T. 39.

Co-type in the Australian Museum, Sydney, No. W. 369.

Four specimens of this species, two of which were sectioned, were obtained from the body-cavity of the sting-ray. The posterior part of the body is almost circular, with a short blunt anterior part. It may be compared to the petal of a flower in which the lamina is circular and the claw short and blunt. The length of the animal varies from 3·3 to 3·76 mm., the breadth from 3 to 3·5 mm. The integument is smooth, without spines of any kind. The mouth-opening is terminal, the oral sucker bowl-shaped and deep, but the ventral sucker

¹ πολυς and κλαδος (branch), referring to the branches of the intestinal limbs.

is flat and shallow. The diameter of the oral sucker varies in the various specimens from 0.375 to 0.424 mm., while that of the ventral varies from 0.636 to 0.652 mm., the average ratio of the oral to the ventral being 1 : 1.6. The musculature of the body-walls is only poorly developed.

A strongly developed muscular pharynx, 0.25 mm. in diameter, leads directly out of the oral sucker, and is joined posteriorly by an œsophagus of rather less length, 0.195 mm. The intestinal limbs, which run some distance from the lateral edges of the body, roughly dividing it into thirds (fig. 13), do not quite reach the posterior end, and throughout their course give off about a dozen short branches from each side.

The excretory pore lies on the dorsal surface near the posterior end, and leads into a long tubular vesicle which runs forwards as far as the ovary, coursing dorsal to the uterus, and giving off a few small branches in its course.

The cerebral ganglia lie one on each side of the œsophagus, with the usual dorsal commissure and a pair of lateral cords that run backwards outside the intestinal limbs, giving off numerous short branches.

The genital pore lies on the ventral surface, in the middle line, just beneath the intestinal fork. The testes are very large, more or less compact bodies, lying wholly outside the intestinal limbs. From the posterior edge of the ventral sucker they extend backwards to within half their length of the posterior extremity. Each testis is divided up into two or three pieces, each of which is deeply lobed. The two vasa deferentia join near the middle of the ventral sucker and immediately enter the vesicula seminalis, which is long, tubular and coiled. The cirrus sac and ejaculatory duct are very poorly developed.

The ovary consists of three rounded lobes, and in its greatest diameter measures 0.326 mm. A small "shell-gland" lies on its left side, and just in front of it a receptaculum seminis, somewhat smaller than the ovary. The yolk-glands consist of fifteen to twenty small rounded

follicles (0·064 mm. in diameter) grouped in two fairly compact masses. They do not extend outwards beyond the inner edge of the intestinal limbs, but lie fairly close together, one on either side of the ovary. This does not quite agree with Looss' definition of the sub-family, "Dotterstöcke aus einander gerückt" (33, p. 863), and perhaps that definition is a little too narrow. The short, directly transverse yolk-ducts meet in a small yolk-reservoir lying ventral to the "shell-gland" and opening into the ootype by a comparatively long duct.

The coils of the uterus, never far from the middle longitudinal line, are confined laterally to the space within the intestinal limbs, but they extend a little further back, running out between the two ends of the intestine.

The eggs are rather long and narrow, 0·052–0·063 mm. in length by 0·023 mm. broad.

*Petalodistomum cymatodes*¹ sp. n. (Fig. 14.)

Diagnosis.—Above middle size, petal-like in shape. Oral and ventral suckers equal in size. Intestinal limbs unbranched but undulating. Genital pore behind the intestinal limbs. Testes consisting of a large number of widely diffused small follicles. Vesicula seminalis comparatively short. Ovary mulberry shaped. Yolk-glands, in the form of branching tubes, not extending outwards beyond the intestinal limbs.

Parasitic in the body-cavity of the leopard ray, *Dasybatis kuhlii*.

Type-specimen in the Museum of the Australian Institute of Tropical Medicine, Townsville, No. T. 40.

P. cymatodes, 10·5 mm. long by 8 mm. broad, is a good deal larger than its congener, but resembles it in shape. The oral and ventral suckers are about the same size, 1·14 mm. in diameter. The pharynx, which is obviously contracted in its longitudinal axis, measures 0·293 mm. by 0·538 mm. wide.

¹ Κυματοῶδες, abounding in waves, referring to the intestinal limbs.

The intestinal limbs are unbranched, but are thrown into a number of snake-like undulations.

The genital pore is in the middle line, midway between the intestinal fork and the anterior edge of the ventral sucker. The vesicula seminalis and cirrus sac are short, and smaller than in *P. polycladum*.

The testes consist of about fifty small rounded follicles on each side, 0.107–0.129 mm. in diameter, and lying more or less dispersed from one another, in the region between the intestinal limbs and the lateral edges of the body. The ducts from the separate follicles join up in groups of five or six and enter a main longitudinal vas deferens on each side; these two vessels join one another at the base of the vesicula seminalis.

The ovary (0.375 by 0.244 mm.) is comparatively small, and is mulberry shaped. The receptaculum seminis is much larger, 0.73 × 0.57 mm.

The yolk-glands, on each side, consist of a much-branched tube rather than of follicles, and, while lying further apart than in *P. polycladum*, do not stretch outwards beyond the inner limit of the intestinal limbs. The extension of the uterus also coincides with that of *P. polycladum*. The eggs are larger, and especially broader than in the last-named species, being 0.06–0.064 in length by 0.03 mm. broad, and many of them are seen to be provided with a short spike at one end.

Only a single specimen of this worm was obtained from its host, the leopard ray, *Dasybatis kuhlii*, where it occurred in the body-cavity.

From the Australian Institute of Tropical Medicine and the Biological Department of the University of Sydney.

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EXPLANATION OF PLATES 22—27,

Illustrating Mr. S. J. Johnston's paper "On some Queensland Trematodes, with Anatomical Observations and Descriptions of New Species and Genera."

[The drawings, which were done by Mr. F. W. Atkins, of the Technical College, Sydney, were all made with the help of the camera lucida. The micro-photographs are from "untouched-up" negatives of sections and whole mounts.]

REFERENCE LETTERS.

c. g. Cerebral ganglion. *c. s.* Cirrus sac. *Ej. d.* Ejaculatory duct. *E.* Excretory vessel. *Ex. p.* Excretory pore. *Ex. v.* Excretory vesicle. *F. c.* Flame-cell. *G. p.* Genital pore. *G. s.* Genital sinus. *int.* Intestinal limbs. *L. c.* Laurer's canal. *L. t.* Lateral nerve-trunk. *M. o.* Mouth-opening. *N.* Nervous system. *Œs.* Œsophagus. *O. s.* Oral sucker. *O.* Ovary. *O. d.* Oviduct. *P.* Penis. *Ph.* Pharynx. *Pr.* Prostate. *R. s.* Receptaculum seminis. *S. g.* "Shell-gland." *Te.* Testis. *Ut.* Uterus. *Vag.* Vagina. *V. d.* Vas deferens. *V. s.* Vesicula seminalis. *V. Sk.* Ventral sucker. *Y. d.* Yolk-duct. *Y. g.* Yolk-gland. *Y. r.* Yolk-reservoir.

Rhabdiopœus taylori, figs. 1-4.

Fig. 1.—Drawn from a cleared and transparent object mounted with the dorsal side uppermost. $\times 8$.

Fig. 2.—Posterior end, showing the multiple proboscis retracted into its complex sheath. $\times 21$.

Fig. 2A.—Egg from the proximal part of the uterus. $\times 550$.

Fig. 2B.—Egg from the distal part of the uterus. $\times 550$.

Fig. 3.—Transverse section through one of the proboscoïdes about its middle. $\times 110$. *C. c.* Central cavity. *c. m.* Circular muscle-fibres. *G. c.* Gland-cell. *L. m.* Longitudinal muscle-fibres. *R.* Bundles of rhabdites.

Fig. 4.—Transverse section through proboscis near its tip. $\times 230$. *R.* = single rhabdites.

Typhlocœlum reticulare, figs. 5-7.

Fig. 5.—Whole mount. $\times 30$.

Fig. 6.—Excretory system, $\times 21$. Compiled from a series of horizontal longitudinal sections, by the camera lucida. *F. c.* Flame-cells. *cap.* Capillary vessel. *net.* Network of vessels.

Fig. 7.—Nervous system, $\times 21$. Compiled in the same manner and from the same series as used in fig. 6. *p. c.* Posterior commissure.

Fig. 8.—Allopyge antigones. $\times 7$.

Fig. 9.—Diaschistorechis pandus. $\times 10$. Unmounted specimen viewed by direct light.

Fig. 10.—*D. pandus*. $\times 20$. *G. c.* Gland-cells surrounding the termination of the vagina.

Fig. 11.—*Pleorechis oligorechis*. $\times 14$. Viewed as a transparent object from the dorsal aspect.

Fig. 12.—*Steringotrema pulchrum*. $\times 24$.

Fig. 12A. Egg with operculum.

Fig. 12B. Egg from which the operculum has been removed. $\times 550$.

Fig. 13.—*Petalodistomum polycladum*. $\times 21$.

Fig. 14.—*Petalodistomum cymatodes*. $\times 11$. *Ex. v.* Excretory vessel.

MICRO-PHOTOGRAPHS.

Rhabdiopœus taylori, figs. 15-26.

Fig. 15.—Part of a longitudinal sagittal section showing spines, thick ventral cuticle and the arrangement of the fibres in the muscular system. $\times 50$. *C. m.* Circular muscle. *D. v. m.* Dorso-ventral muscle. *L. m.* Longitudinal muscle. *N. c.* Nerve-cord. *O. m.* Oblique muscle. *Sp.* Spine.

Fig. 16.—Part of a transverse section showing the arrangement of the muscle-fibres in the muscular system of the body and in the cirrus sac and vagina. The section also shows the very thick cuticle and the spines in transverse section. $\times 89$.

Fig. 17.—Transverse section showing the bifid nature of the ventral spines. $\times 54$.

Fig. 18.—Horizontal longitudinal section showing the relations of the nervous system, the alimentary canal and the excretory vessels. $\times 20$.

Fig. 19.—Transverse section showing the brain. $\times 51$.

Fig. 20.—Transverse section through the proboscis chamber and

tunnels, cutting one proboscis longitudinally and showing the tunnels or sheaths filled with mucus and rhabdites. $\times 53$. *P. c.* Cavity in the proboscis. *M. r.* Mucus with rhabdites. *Ex. v.* Branches from the excretory vesicle.

Fig. 21.—Transverse section through the proboscis chamber, excretory vesicle and excretory pore, showing the relations of the excretory vesicle to the proboscis chamber. $\times 45$. *Pb. ch.* Proboscis chamber.

Fig. 22.—Transverse section a little further forward than the two foregoing, showing the excretory vessel leading from the vesicle into the central cavity of one of the arms of the proboscis. $\times 45$. *Pb.* Proboscis, cut obliquely.

Fig. 23.—Transverse section passing through the three anterior arms of the proboscis, showing them lying in their sheaths or tunnels. $\times 20$. *Pb. s.* Proboscis sheath or tunnel.

Fig. 24.—Transverse section cutting the cirrus sac in the region of the vesicula seminalis. $\times 73$.

Fig. 25. Transverse section through the cirrus sac in the region of the prostate. $\times 85$.

Fig. 26.—Horizontal longitudinal section showing the anterior arch of the excretory vessels. $\times 70$.

Typhlocœlum reticulare, figs. 27-30 and 33.

Fig. 27.—Horizontal longitudinal section showing nerve-cords and ventral network of nerves. $\times 70$.

Fig. 28.—Photograph of whole mount, focussed about the middle of its thickness, showing the characteristic dorso-ventral winding of the uterus. $\times 20$.

Fig. 29.—Horizontal section through the anterior end, showing the relations of the cerebral ganglia and pharynx. $\times 53$.

Fig. 30.—Transverse section about the middle of the body, showing the characteristic coils of the uterus. $\times 53$.

Allopyge antigones, figs. 31 and 32.

Fig. 31.—Transverse section (somewhat oblique) through the pharynx and base of the "oral sucker," showing the muscle-fibres in the walls of the latter. $\times 56$.

Fig. 32.—Transverse section in the region of the ovary, showing the receptaculum seminis and "shell-gland." $\times 45$.

Fig. 33.—Typhlocœlum reticulare, horizontal longitudinal section, showing the network of excretory vessels. $\times 60$.

Diaschistorchis pandus, figs. 34-37.

Fig. 34.—Horizontal longitudinal section, showing alimentary canal, cirrus sac and the related parts, uterus and yolk-glands. $\times 48$.

Fig. 35.—Part of a transverse section passing through the genital aperture, showing the genital sinus, vagina and penis. $\times 82$.

Fig. 36.—Part of a transverse section passing through the vagina and the cirrus sac in the region of the ejaculatory duct, showing the very thick muscular wall of the sac. $\times 51$.

Fig. 37.—Horizontal longitudinal section, showing the separate testes and general anatomy. $\times 15$.

Pleorchis oligorchis, figs. 38-40.

Fig. 38.—Horizontal longitudinal section, showing alimentary canal (partly filled up with host's blood), œsophagus, excretory vesicle and main relations of the reproductive organs. $\times 24$.

Fig. 39.—Part of transverse section passing through the ventral sucker near its posterior edge, and showing the genital sinus, vagina and male duct, with prostate lying free in the body parenchyma. $\times 51$.

Fig. 40.—Transverse section in the region of the ovary, showing ovary, "shell-gland," yolk-duct, oviduct, receptaculum seminis and Laurer's canal. $\times 51$.

Steringotrema pulchrum, figs. 41 and 42.

Fig. 41.—Longitudinal sagittal section a little to one side of the median plane, showing general anatomy. $\times 26$.

Fig. 42.—Transverse section in region of the ovary, showing Laurer's canal, oviduct, etc., and the relations of the intestinal and excretory tubes. $\times 53$.